

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventors : BRAUN, Erez; EICHEN, Yoav; SIVAN, Uri,
BEN-JOSEF, Gdalyahu
Assignee : TECHNION RESEARCH AND DEVELOPMENT
FOUNDATION LTD.
Application No. : 09/462,171
Filing Date : March 27, 2000
Title : *Microelectronic Components and Electronic Networks
Comprising DNA*
Examiner : J. Jackson Jr.



DECLARATION

1. I, the undersigned, Yoav Eichen, Israeli citizen residing at Haifa Israel, after having been warned to state the truth and that I shall be liable to penalties prescribed by Law if I shall not do so hereby declare in writing as follows:
2. I am one of the inventors of the above-captioned patent application.
3. I am a professor at Technion – Israel Institute of Technology.

My *Curriculum Vitae* and list of publications is attached hereto as **Exhibit A**.

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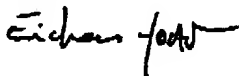
- (1) Attaching DNA to two conductive electrodes placed on an insulating substance.
- (2) Replacing the counterions on DNA by metal ions.
- (3) Reducing the DNA-bound silver ions into silver islands; and
- (4) Using the silver islands as nucleation centers for subsequent catalytic metal deposition in order to allow for efficient metal covering of the DNA and ensure the formation of a continuous metal substance along it.

10. All experiments specified above were conducted by me and by my co-inventors of the above application, Uri Sivan, Erez Braun and Gidi Ben-Yoseph.

11. The experiments specified above demonstrated that electricity cannot be carried along a nucleotide fiber when metal particles attached to it do not form a continuous stretch along the fiber.

12. I further declare that all statements made herein of my own knowledge are true and that all statements on information I believe to be true; and further that these statements are made with the knowledge that wilful false statements and the like so made are punishable by fine or imprisonment or both, under Section 1001, Title 18 of the United States Code and that such wilful false statements may jeopardize the validity of the application or any patent issued thereon.

Dated this 15 day of April 2002



Yoav Eichen

4. One of our experiments, that was presented in details in a paper in "Nature" (attached hereto as **Exhibit B**) reports on the DNA-templated assembly and electrode attachment of a conducting silver wire. The paper presents a novel method for assembling a conductive wire using a DNA template. As presented in the paper, the process of rendering the DNA conductive involves four steps:
 - (1) Attaching DNA to two conductive electrodes placed on an insulating substance.
 - (2) Replacing the counterions on DNA by silver ions.
 - (3) Reducing the DNA-bound silver ions into silver islands.
 - (4) Using the silver islands as nucleation centers for subsequent catalytic metal deposition in order to allow for efficient metal covering of the DNA and ensure the formation of a continuous metal substance along it.
5. In the paper of exhibit B we comment on some control experiments that were performed in order to prove the role of DNA template and silver deposition in the process.
6. Additionally, another control experiment of the following sequence was performed:
 - (1) Attaching DNA to two conductive electrodes placed on an insulating substance.
 - (2) Replacing the counterions on DNA by silver ions.
 - (3) Reducing the DNA-bound silver ions into silver islands.
 - (4) Measuring conductivity between the two electrodes.
7. In all of the above control experiments, the resistance of the silver islands loaded DNA was higher than $10^{13}\Omega$, an evidence for the importance of the step of using the silver islands as nucleation centers for subsequent catalytic metal deposition in the process of the assembly of the wire.
8. The same conclusion was also derived from similar experiments where DNA was loaded with metal (gold) clusters and particles. In all such cases, a continuous metal lattice is not formed and the resulting wire is non-conductive.

9. It is therefore our conclusion that in order to attain reasonable conductivity (not of an insulator) in a DNA-templated assembled metal wire one needs to achieve the formation of a continuous metal lattice. This can be done for example by applying the following steps:
- (1) Attaching DNA to two conductive electrodes placed on an insulating substance.
 - (2) Replacing the counterions on DNA by metal ions.
 - (3) Reducing the DNA-bound silver ions into silver islands; and
 - (4) Using the silver islands as nucleation centers for subsequent catalytic metal deposition in order to allow for efficient metal covering of the DNA and ensure the formation of a continuous metal substance along it.
10. All experiments specified above were conducted by me and by my co-inventors of the above application, Uri Sivan, Erez Braun and Gidi Ben-Yoseph.
11. The experiments specified above demonstrated that electricity cannot be carried along a nucleotide fiber when metal particles attached to it do not form a continuous stretch along the fiber.
12. I further declare that all statements made herein of my own knowledge are true and that all statements on information I believe to be true; and further that these statements are made with the knowledge that wilful false statements and the like so made are punishable by fine or imprisonment or both, under Section 1001, Title 18 of the United States Code and that such wilful false statements may jeopardize the validity of the application or any patent issued thereon.

Dated this 11 day of April 2002

Yoav Eichen

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